

The Impact of Digital Economy on China's Coastal Foreign Trade--Mediation Effect Based on E-Commerce and Urbanisation Level

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Abstract— Against the backdrop of intensifying global trade frictions and rising geopolitical risks, the development of foreign trade in China's coastal regions faces many challenges. At the same time, the rapid development of digital economy provides new opportunities for foreign trade, promoting industrial upgrading and enhancing trade efficiency. Current research mainly focuses on the direct impact of digital economy on foreign trade. Meanwhile, this study fills the current research gap by exploring how the digital economy affects foreign trade through e-commerce and the level of urbanization. This study aims to analyze the direct impact of the digital economy on China's coastal foreign trade, and to explore the mediating role of e-commerce and urbanization level to reveal its mechanism of action. At the same time, the study will examine the regional heterogeneity of this impact and clarify the differences in the impact of the digital economy in different coastal regions. Based on econometric theory, panel data theory, mediating effect theory and new trade theory, this study constructs a panel data model, an econometric model and a mediating effect model to test the hypotheses. The digital economy index is measured by entropy method and principal component analysis, and Robustness test, Endogeneity test and Heterogeneity analysis are used to ensure the credibility and accuracy of the regression results. The results of this study highlight the important role of the digital economy in promoting China's coastal foreign trade and the mediating effect that exists between e-commerce and the level of urbanisation.

Keywords: Digital Economy, E-commerce, Urbanisation Level, Foreign Trade

I. INTRODUCTION

Since the twenty-first century, the rapid development of digital technologies represented by the Internet, artificial intelligence, big data and so on has given rise to a completely new economic form -- the digital economy. This economic form has not only risen rapidly, but also profoundly changed the structure of the global economy, its mode of operation and its mode of development.

However, in recent years, international trade frictions, geopolitical risks and fluctuations in demand in the global market have made coastal foreign trade face severe challenges. Meanwhile, the rapid development of digital economy is profoundly changing the global trade pattern. As the core zone of China's foreign trade, the coastal region has once again become the focus of research and practice. For example, Luo and Zhang (2022), from the three dimensions of commodities, regions and trading partners, deeply analyze the reasons for the decline in China's trade growth rate, and empirically analyze the far-reaching impact of foreign trade of the coastal areas on GDP. An and Xinling (2022), on the other hand, focus on the potential of agricultural trade between China and Southeast Asian countries, revealing the important role of coastal regions in promoting foreign trade growth and boosting GDP. So this paper will explore the direct impact of digital economy on China's coastal foreign trade.

In order to deeply study the impact of the digital economy on coastal foreign trade, this study will use the mediated effect model to reveal the mechanism of e-commerce and urbanization level in the relationship between the two. The mediated effect model is a statistical analysis method that can reveal the transmission path between the dependent variable and the independent variable through the mediating variables (e-commerce and urbanization level in this study). By constructing the mediation effect model, this study will analyze the role path of e-commerce and urbanization level in the promotion of foreign trade by the digital economy, and further explore how the digital economy can expand the scale of foreign trade and optimize the structure of foreign trade through e-commerce and urbanization level.

II. LITERATURE REVIEW

With regard to the establishment of digital economy indicators, by making an analysis of the digital foundations and digital applications proposed by Pei (2018), Bughin et al. (2019), Bukht and Heeks (2018), Liu and Yang (2020), information and communication technology (ICT) proposed by Jorgenson and Vu (2016) and Castells (2000) on the classification of the digital economy.

A more detailed method of measuring the digital economy was selected. As shown in Table 1.

Table 1: Indicators for Measuring the Digital Economy

	Primary Indicators	Secondary Indicators	Units
Regarding the calculation of the digital economy index, I found for example that Zhang and Jiao (2017) used Entropy Weights Method to analyze the panel data for the years 2007 -2015, and Yang and Jiang (2021) used Principal Component Analysis to analyze the data, and in this paper, in order to improve the credibility of the results, we will use these two ways to calculate the digital economy index.	Digital	Number of Internet access ports	million
	Foundation	Number of domain names	million
		Number of IPV4s	million
		Cell phone penetration rate	Parts/100 people
		Length of fiber optic cable per unit area	kilometer
	Digital Applications	Number of information technology companies	Size
		Number of websites per 100 enterprises	Size
		Share of enterprises with e-commerce trading activities	%
		E-commerce sales	Billions of Yuan
		Software Business Revenue	Billions of Yuan
When analyzing the influencing factors of foreign trade development, the choice of control variables is crucial. According to Niu (2021), the degree of trade openness is an important influencing factor. Specifically, the degree of trade openness can be assessed by measuring the proportion of the total annual import and export trade of each province to the total GDP. According to Ge and Wu (2021), the government's industrial policies and financial inputs have a significant impact on foreign trade in coastal regions. Song and Ning (2021) point out that an increase in the level of foreign direct investment usually implies an increase in the openness of the regional economy, which in turn expands the size of the foreign trade market. Qin and Shen (2020) show that an increase in GDP per capita increase is usually accompanied by an increase in financial support and labor market inflows, all of which can contribute to an increase in the level of foreign trade. Regarding the impact of province size on foreign trade, studies by Kadir and Al-Mahmoud (2015) and Goh (2017) show that population size has a positive impact on foreign trade.	Digital	Digital Finance Depth of Use Index	
	Industry	Digital Finance Digitization Degree	
		Breadth of Digital Finance Coverage Index	

The digital economy profoundly affects the global trade pattern through multiple channels. Freund & Weinhold (2004) show that digital technology significantly reduces trade costs, and every 10 per cent increase in Internet penetration can lead to trade growth of 1.7 per cent. Lendle et al. (2016) Cross-border e-commerce platforms enable small and medium-sized enterprises (SMEs) to directly participate in global trade and promote trade model innovation and services trade expansion. Meanwhile, Jiang (2020) digital economy promotes trade structure upgrading and raises the proportion of exports of high-tech products, but the digital divide may exacerbate trade imbalance.

Regarding the impact of e-commerce and the level of urbanisation on foreign trade, Huang et al. (2017) show that e-commerce reduces transaction costs and improves market efficiency, which in turn promotes the growth of international trade. Zhang et al. (2020) suggest that through e-commerce platforms, firms are able to access market information more effectively and enhance their market responsiveness. In addition, Gao et al. (2021) point out through empirical research that e-commerce not only reduces information asymmetry and transaction costs, but also enhances firms' competitiveness in the international market. This increased competitiveness enables firms to make more efficient use of global resources and optimise production and distribution processes. Henderson V. (2010) proposed a positive correlation between the level of urbanisation and economic development, pointing out that cities are at the heart of innovation and economic growth. Brueckner J. K. (2013) examined the positive effects of urbanisation on foreign trade, in particular how infrastructure improvement how it accelerates the development of international trade.

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III. METHODOLOGY AND MODELS

3.1 Panel Data Model

Panel data analysis usually uses three types of models: fixed effects, random effects, and mixed effects. The selection process first determines whether it is appropriate to use fixed effects or mixed effects through the F test. If the result is significant at the 5% level and rejects the null hypothesis, the mixed effects model is excluded. The Hausman test must then be performed to

distinguish between fixed and random effects models. When the test also shows a 5% significance level and rejects the null hypothesis, the analysis should use the fixed effects method instead of the random effects method. The basic form of the panel data model is as follows:

$$Y_{it} = \alpha + \beta X_{it} + \varepsilon_{it} + u_i + \eta_t \quad (1)$$

Where Y_{it} is the explained variable, X_{it} is the explanatory variable, α is the intercept term, β is the slope term, ε_{it} is the error term, i denotes the cross-sectional dimension, while t denotes the time dimension. u_i is individual effect, η_t is period effect.

3.2 Econometric Model Construction

In order to study the impact of digital economy development on China's coastal foreign trade, this paper constructs an econometric model with coastal foreign trade trade (lnFT) as the explained variable and the level of digital economy development (DE) as the explanatory variable, in which the control variables are the degree of trade openness (Openness), the foreign investment (lnFDI), province size (lnPE), the government intervention level (Gov) and regional economic level (lnLE).

$$\ln FT = \beta_0 + \beta_1 DE_{it} + \beta_2 Openness_{it} + \beta_3 \ln FDI_{it} + \beta_4 \ln PE_{it} + \beta_5 Gov_{it} + \beta_6 \ln LE_{it} + \mu_{it} + u_i + \eta_t \quad (2)$$

Where i represents different provinces and cities, t represents different years, and μ is a random disturbance term. u_i is individual effect, η_t is period effect. lnFT refers to export trade, DE refers to the level of digital economy development, Openness refers to the degree of trade openness, lnFDI refers to foreign investment, lnPE refers to the size of the province, Gov refers to the government intervention level, and lnLE refers to the level of regional economy.

3.3 Mediation Model Construction

This paper studies the mediating role played by e-commerce and the level of urbanization between the digital economy and China's coastal foreign trade, so the mediation model is constructed as follows.

$$\ln FT = \beta_0 + \beta_1 DE_{it} + \beta_2 Openness_{it} + \beta_3 \ln FDI_{it} + \beta_4 \ln PE_{it} + \beta_5 Gov_{it} + \beta_6 \ln LE_{it} + \mu_{it} + u_i + \eta_t \quad (3)$$

$$\text{Med}_{it} = \alpha_0 + \alpha_1 DE_{it} + \alpha_2 Openness_{it} + \alpha_3 \ln FDI_{it} + \alpha_4 \ln PE_{it} + \alpha_5 Gov_{it} + \alpha_6 \ln LE_{it} + \mu_{it} + u_i + \eta_t \quad (4)$$

$$\ln FT = \theta_0 + \theta_1 DE_{it} + \gamma_1 \text{Med}_{it} + \theta_2 Openness_{it} + \theta_3 \ln FDI_{it} + \theta_4 \ln PE_{it} + \theta_5 Gov_{it} + \theta_6 \ln LE_{it} + \mu_{it} + u_i + \eta_t \quad (5)$$

Where Med_{it} is the mediator variable, which here mainly represents e-commerce (EC) and level of urbanization (LU), and the control variables are consistent with the baseline mode.

In order to study the impact of digital economy on China's coastal foreign trade and the mediating effect of e-commerce and urbanisation level, the article applies Mathematical Statistics, Panel Data Analysis, Fixed Effects Theory and Mediating Effect Analysis, and also applies Regional Heterogeneity Analysis to explore the impact of digital economy on coastal foreign trade in different regions.

IV. DATA SOURCES

The proportion of total annual import and export trade to total GDP of each province is selected to measure the degree of trade openness (Openness). The natural logarithm of the amount of foreign direct investment in each province is used to measure the level of foreign investment (lnFDI). This paper uses the natural logarithm of the population size of each province to measure the provincial area (lnPE). This paper uses the ratio of fiscal expenditure to regional GDP of each province to measure the level of government involvement (Gov). This paper uses the natural logarithm of the per capita GDP of each region to measure the economic level of each region (lnLE).

This paper uses the e-commerce sales of each province to represent the level of e-commerce (EC). This paper uses the proportion of local urban population to the total population of the region to measure the urbanisation level of each region (LU).

All data are from annual data from 2012-2022. The choice of regions is limited by China's coast, so 11 provinces and cities along China's coast are chosen, including Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Guangxi and Hainan. All data are from CEEC, World Bank and China Statistical Yearbook.

V. EMPIRICAL ANALYSIS

5.1 Mathematical and Descriptive Statistics

Descriptive statistics are important in summarising information, improving data interpretability and supporting decision making, and are a key starting point for any data analysis. The following Table 2 shows the analysis of descriptive statistics for the independent, dependent and control variables mentioned in this paper.

Table 2: Mathematical and descriptive statistics results

Variables	Obs	Mean	Std. Dev.	Min	Max
lnFT	121	9.343	1.23	6.555	11.327
DE	121	.241	.137	.031	.639
Openness	121	.458	.273	.109	1.293
lnFDI	121	6.343	1.063	3.511	7.722
lnPE	121	8.397	.768	6.813	9.448
Gov	121	.2	.066	.105	.354
lnLE	121	7.436	3.317	2.418	17.991

These statistical descriptions reveal the characteristics of the distribution of the variables in different regions and the degree of variation. China's coastal foreign trade, the digital economy, trade openness and the level of economy across regions show significant differences across regions, while government intervention and province size are more concentrated. This provides initial clues to the distribution of data and potential relationships for subsequent analyses.

5.2 Hausmann Test

Conducting the Hausman test is crucial to the selection of empirical models, in the economics research method, there are direct random effects model, fixed effects model and mixed regression model, the latter does not take into account the variability of the individual, the panel data usually do not take this model, the panel data reflect more comprehensive information at the individual level, so it is necessary to fully distinguish between the differences of the individual, which requires the selection of individual effects model, but whether to choose one of the random effects model or the fixed effects model, the Hausmann test gives the reference answer, as shown in the following Table 3.

Table 3: Hausmann Test Results

Hausmann Test	Coef.
Chi-square test value	15.87
P-value	0.0145

Through the Hausman test, after the Hausman test, the p-value in the Table 3 shows 0.0145, the original hypothesis can be rejected at the 5% level, and the fixed effect model is chosen for better empirical testing.

5.3 Impact of Digital Economy Development on Coastal Foreign Trade

Regarding the study of the impact of the digital economy on China's coastal foreign trade, in order to empirically test it, this section carries out a panel data benchmark regression, in which the model (1) does not add the control variables, and only carries out the regression between the explained variables and the explanatory variables, and in the model (2)-(6), the control variables are added gradually. The specific results are shown in the Table 4.

Table 4: Panel Data Regression Results

Variables	Model(1) lnFT	Model(2) lnFT	Model(3) lnFT	Model(4) lnFT	Model(5) lnFT	Model(6) lnFT
DE	1.486*** (8.022)	2.313*** (11.703)	2.288*** (12.553)	1.770*** (9.396)	1.584*** (9.296)	0.671*** (3.575)
Openness		1.530*** (6.796)	1.340*** (6.326)	1.554*** (8.072)	1.378*** (7.938)	1.702*** (11.423)
lnFDI			0.158*** (4.480)	0.065* (1.801)	0.119*** (3.588)	0.068** (2.434)
lnPE				3.166*** (5.404)	3.666*** (6.955)	2.680*** (5.924)
Gov					-3.364*** (-5.474)	-1.464** (-2.580)
lnLE						0.076*** (7.253)

Table 4(Continued): Panel Data Regression Results

Variables	Model(1) lnFT	Model(2) lnFT	Model(3) lnFT	Model(4) lnFT	Model(5) lnFT	Model(6) lnFT
_cons	8.985*** (188.627)	8.086*** (58.482)	7.177*** (29.958)	- 18.785*** (-3.907)	- 22.535*** (-5.221)	- 14.812*** (-4.013)
N	121	121	121	121	121	121
R2	0.371	0.560	0.629	0.709	0.774	0.850

F	64.357	68.611	60.509	64.647	71.842	98.063
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***p<0.01, **p<0.05, *p<0.10

Note: Standard deviations are shown in parentheses and ***, ** and * indicate significance at 1 per cent, 5 per cent and 10 per cent level of significance respectively.

Model (1): With only *de* as an explanatory variable, the significance is very high ($p < 0.01$) with a regression coefficient of 1.486. This indicates that digital economy has a significant positive impact on total foreign trade and the elasticity with respect to *lnft* is 1.486 when other factors are not included. $r^2 = 0.371$, the explanatory power of the model is low, explaining only 37.1% of the variation. Model (2): With the inclusion of openness (*openness*), both are significant ($p < 0.01$). The impact of digital economy is enhanced (2.313), indicating that the introduction of openness has not weakened the effect of digital economy on foreign trade. $R^2 = 0.560$, the model fit is significantly improved and the explanatory power reaches 56%. Model (3): *lnfdi* is introduced and all variables are significant. The coefficient of digital economy decreases slightly to 2.288 but is still strong. *lnfdi* has a smaller coefficient (0.158) indicating a weaker impact of FDI on foreign trade. $r^2 = 0.629$ and the explanatory power of the model is further improved. Model (4): *lnpe* is added and its coefficient is 3.166 ($p < 0.01$), indicating that per capita education expenditure has a strong positive effect on foreign trade. At this point, the coefficient of digital economy decreases to 1.770, but is still significant. $r^2 = 0.709$, the fit of the model is significantly improved. Model (5): with the addition of *gov*, the coefficient is -3.364 ($p < 0.01$), indicating that government intervention has a significant negative effect on total foreign trade. At this point, the coefficient of digital economy decreases to 1.584. $r^2 = 0.774$, the explanatory power of the model is further enhanced. Model (6): the most comprehensive model with the addition of *lnle*. the coefficient of digital economy decreases to 0.671, but is still significant. This may be due to the existence of some correlation between the variables. the positive effect of *lnle* is significant (0.076, $p < 0.01$). with $R^2 = 0.850$, the explanatory power is at its highest level and the model is able to explain 85% of the variation in *lnft*.

The effect of the digital economy is always significant in all models, indicating a strong positive contribution to total foreign trade. However, with the addition of other control variables, the coefficient of digital economy gradually decreases, reflecting that part of the impact may be indirectly reflected through other variables (such as openness, economic development level, etc.). openness is significant in models (2) to (6), with coefficients roughly ranging from 1.3-1.7, indicating that openness to the outside world has a sustained and stable effect on the total amount of foreign trade. *lnpe* and *lnle* coefficients indicate that the size of each province and the size of each region have a positive impact on the total amount of foreign trade. The coefficients of *lnpe* and *lnle* indicate that the size of each province and the level of economic development of each region are the two important driving factors of foreign trade growth. the negative coefficient of *gov* indicates that too much government intervention may have a dampening effect on foreign trade, which is worthy of attention. the R^2 improves from 0.371 to 0.850, which indicates that the gradual introduction of the variables significantly improves the explanatory power of the model. This shows that the development of digital economy will significantly promote China's coastal foreign trade.

5.4 Heterogeneity Analysis

In order to study the regional differences of the digital economy on China's coastal foreign trade, this paper divides China's 11 coastal provinces (cities) into the Pearl River Delta, the Yangtze River Delta and the Bohai Rim. And the heterogeneity analysis is carried out by means of interaction term regression.

Table 5: Results of Heterogeneity Analysis

Variables	Model(1) <i>lnFT</i>	Model(2) <i>lnFT</i>	Model(3) <i>lnFT</i>
<i>DE</i>	8.824*** (15.237)	1.018 (1.083)	2.993*** (3.789)
<i>Bohai Rim</i>	1.812*** (6.510)		-0.553 (-1.655)
<i>Yangtze River Delta</i>	2.364*** (8.126)	0.553 (1.655)	
<i>Pearl River Delta</i>		-1.812*** (-6.510)	-2.364*** (-8.126)
<i>c.DE#c.Bohai Rim</i>	-7.806*** (-7.066)		-1.975 (-1.608)
<i>c.DE#c.Yangtze River Delta</i>	-5.831***	1.975	

Table 5(Continued): Results of Heterogeneity Analysis

Variables	Model(1) <i>lnFT</i>	Model(2) <i>lnFT</i>	Model(3) <i>lnFT</i>
<i>c.DE#c.Yangtze River Delta</i>	-5.952	1.608	
<i>c.DE#c.Pearl River Delta</i>		7.806*** (7.066)	5.831*** (5.952)

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cons	6.939*** (43.655)	8.750*** (38.303)	9.303*** (38.170)
N	121	121	121
R²	0.765	0.765	0.765
F	74.909	74.909	74.909

***p<0.01, **p<0.05, *p<0.10

According to the regression results showing the Bohai Rim region, the main effect is positive (1.812, p<0.01) in Model 1, suggesting that it has a facilitating effect on foreign trade. After the introduction of the interaction term (Model 3), the main effect becomes negative (-0.553, p>0.1), which may reflect the weakened role of digital economy in the region.

In the Yangtze River Delta, the main effect is significantly positive (2.364, p<0.01), indicating that the region has a significant advantage in foreign trade. The interaction effect of digital economy is not significant in both Model 2 and Model 3, indicating that the marginal contribution of digital economy to the YRD may be stabilising.

In the PRD, the main effect was significantly negative (-1.812 to -2.364, p<0.01), but the interaction effect was significantly positive (5.831 to 7.806, p<0.01). This suggests that, despite the lower level of basic foreign trade in the PRD, the digital economy is the most significant driver in the region, and it is the core region of the digital economy for foreign trade development.

The interaction term coefficients for the Bohai Rim (c.DE#c.Bohai Rim) and Yangtze River Delta (c.DE#c.Yangtze River Delta) are negative, at -7.806 and -5.831, respectively, suggesting that the marginal benefits of the digital economy in these regions are relatively low, possibly due to the industrial structure or insufficient application of technology. The coefficients of the interaction terms in the Pearl River Delta (c.DE#c.Pearl River Delta) are significantly positive, ranging from -5.831 to -7.806, suggesting that the digital economy has the strongest effect in the Pearl River Delta in promoting foreign trade.

The analysis of the actual situation and the regression data reveals that the Pearl River Delta region, with its high degree of openness, developed manufacturing industry and cross-border e-commerce advantages, has become the core region of the digital economy to promote the development of foreign trade, and the interaction effect is significantly positive. The Yangtze River Delta region has a strong economic foundation, but the marginal role of digital economy tends to be stable, and the promotion of foreign trade is relatively limited. The Bohai Rim region, due to its industrial structure dominated by heavy industry, the traditional foreign trade model is more dependent on resource-intensive industries, and the promotion of foreign trade by the digital economy has been limited to a certain extent, with a lower marginal effect. This regional difference mainly stems from the differences in industrial structure, technology application level, digital infrastructure construction and policy support. Therefore, regions need to combine their own characteristics, optimise industrial structure, promote the deep integration of digital economy and foreign trade, and comprehensively enhance the competitiveness of foreign trade.

5.5 Mediation Effects

5.5.1 Mediation Effect of E-Commerce

The mediation effect model and the regression of the panel data resulted in the following Table 6.

Table 6: Mediation Effect Result (E-Commerce)

Variables	Model(1) lnFT	Model(2) EC	Model(3) lnFT
DE	0.671*** (3.575)	2.704*** (5.287)	0.344* (1.715)
EC			0.121*** (3.541)
Control	Yes	Yes	Yes
_cons	-14.812*** (-4.013)	-29.113*** (-2.896)	-11.290*** (-3.101)
Sobel		0.037(z=2.088)	
Aroian		0.039(z=2.068)	
Goodman		0.035(z=2.110)	
Indirect effect		0.037(z=2.088)	
N	121	121	121
R²	0.850	0.819	0.866

Table 6(Continued): Mediation Effect Result (E-Commerce)

Variables	Model(1) lnFT	Model(2) EC	Model(3) lnFT
F	98.063	78.639	95.171

***p<0.01, **p<0.05, *p<0.10

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The regression results show that the digital economy (DE) has a significant positive effect on the size of foreign trade (lnFT) and its effect is partly realised indirectly through e-commerce (EC). Specifically, the regression results show that:

Model (1) shows that DE has a significant direct contribution to the growth of foreign trade (coefficient 0.671, $t=3.575$, $p<0.01$), which implies that the development of the digital economy can directly contribute to the expansion of foreign trade scale.

Model (2) confirms the promotion effect of DE on e-commerce (EC) (coefficient of 2.704, $t=5.287$, $p<0.01$). With the promotion of digital economy, e-commerce plays an increasingly important role in global trade, especially by reducing the intermediary links in traditional trade, which enhances the liquidity and efficiency of the market.

Model (3) further shows that e-commerce (EC) has a significant effect on the growth of foreign trade (coefficient of 0.344, $t=1.715$, $p<0.10$). After the introduction of EC, the direct impact of DE on foreign trade is weakened (the coefficient decreases from 0.671 to 0.344), which indicates that e-commerce plays a partly intermediary role between the digital economy and the growth of foreign trade. EC indirectly promotes the growth of foreign trade by optimising the transaction mode, improving the speed of information transmission and broadening the channels of international markets.

In terms of the test of mediation effect, the results of Sobel, Aroian and Goodman's test all indicate that the indirect effect is significant (0.037, $p<0.05$), which verifies the mediating role of e-commerce between digital economy and foreign trade. This further supports e-commerce as an important channel for the digital economy to drive foreign trade growth.

The possible reason for this is that e-commerce facilitates SMEs' participation in foreign trade by lowering transaction costs, improving market efficiency, and reducing transactional friction, especially in the context of globalisation and informatisation, which opens up more convenient cross-border trade channels for enterprises.

To summarise, the direct impact of the digital economy remains, but e-commerce, as one of the key channels, significantly enhances the impact of the digital economy on the scale of foreign trade. The digital economy not only directly contributes to foreign trade growth by improving industrial structure and promoting technological innovation, but also further promotes the internationalisation and efficiency of foreign trade by facilitating the expansion and application of e-commerce.

5.5.2 Mediation Effect of Urbanisation Level

The mediation effect model and the regression of the panel data resulted in the following Table 7.

Table 7: Mediation Effect result (Urbanisation Level)

Variables	Model(1) lnFT	Model(2) LU	Model(3) lnFT
DE	0.671*** (3.575)	0.225*** (6.395)	0.409* (1.880)
LU			1.167** (2.276)
Control _cons	Yes -14.812*** (-4.013)	Yes -3.229*** (-4.668)	Yes -11.042*** (-2.774)
Sobel		0.022(z=2.293)	
Aroian		0.024(z=2.255)	
Goodman		0.020(z=2.333)	
Indirect effect		0.022(z=2.293)	
N	121	121	121
R ²	0.850	0.772	0.857
F	98.063	58.565	88.171

*** $p<0.01$, ** $p<0.05$, * $p<0.10$

The regression results show that the digital economy (DE) has a significant positive effect on the size of foreign trade (lnFT) and part of the effect is indirectly realised through the level of urbanisation (LU). The specific analyses are as follows:

Model (1) shows that DE has a significant positive effect on lnFT (coefficient 0.671, $t=3.575$, $p<0.01$), indicating that digital economy can directly promote the growth of foreign trade scale.

Model (2) further shows that DE also has a significant positive effect on LU (urbanisation level) (coefficient 0.225, $t=6.395$, $p<0.01$), i.e. the development of digital economy promotes the process of urbanisation.

Model (3) finds that LU also has a significant positive effect on lnFT (coefficient 1.167, $t=2.276$, $p<0.05$), i.e. the increase in the level of urbanisation contributes to the growth in the size of foreign trade. In addition, the coefficient of DE decreases to 0.409 ($t=1.880$, $p<0.10$) after the addition of LU, and the significance is weakened, suggesting that LU plays a partly mediating role between digital economy and foreign trade.

From the perspective of the mediating effect, the results of Sobel, Aroian and Goodman tests all show a significant indirect effect (0.022, $z=2.293$, $p<0.05$), supporting the mediating role of LU between DE and lnFT. This suggests that the digital economy indirectly promotes the growth of foreign trade by promoting the increase of urbanisation level, and then indirectly promotes the growth of foreign trade.

The possible reason is that the digital economy indirectly promotes the level of urbanisation by increasing productivity, accelerating industrial agglomeration, facilitating information flow and optimising resource allocation. Urbanisation brings with it higher consumer demand, more labour agglomeration, and better infrastructure, which together drive foreign trade growth.

In summary, the digital economy affects foreign trade directly and the scale of foreign trade indirectly through the level of urbanisation, demonstrating the mediating role of urbanisation in the digital economy's promotion of foreign trade.

VI. CONCLUSION

This study examines the impact of the digital economy on foreign trade in China's coastal areas and finds that the digital economy has a significant positive impact on foreign trade. It also investigates the mediating effect of e-commerce and urbanisation level, revealing its mechanism of action. This impact is partly achieved indirectly through e-commerce and urbanisation level. Specifically, e-commerce promotes foreign trade growth by reducing transaction costs and improving market efficiency, while the level of urbanisation indirectly promotes foreign trade development by increasing consumer demand and optimising resource allocation. In addition, through the analysis of regional heterogeneity, the study also finds that the digital economy in the Pearl River Delta region has the most significant role in promoting foreign trade, while the marginal effect in the Bohai Rim region is relatively low. The results of the study provide a theoretical basis for regions to optimise their industrial structure and promote the deep integration of digital economy and foreign trade.

Based on the research conclusion, this paper proposes the following suggestions: 1. Strengthen the construction of digital infrastructure. 2. Promote the high-quality development of cross-border e-commerce. 3. Promote the integration of digital technology and industry. 4. Implement regional differentiation strategy.

Regarding future research, the following directions can be further explored: the impact of the digital economy on sub-sectors such as service trade and green trade; the long-term effect of digital trade rules (such as cross-border data flow) on China's foreign trade; the disruptive changes in trade models brought about by emerging technologies such as artificial intelligence and blockchain.

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